sphere™
powered by HOLOPLOT

Catapulting live entertainment into the future

X1 delivers perfect sound for the world's most advanced concert venue

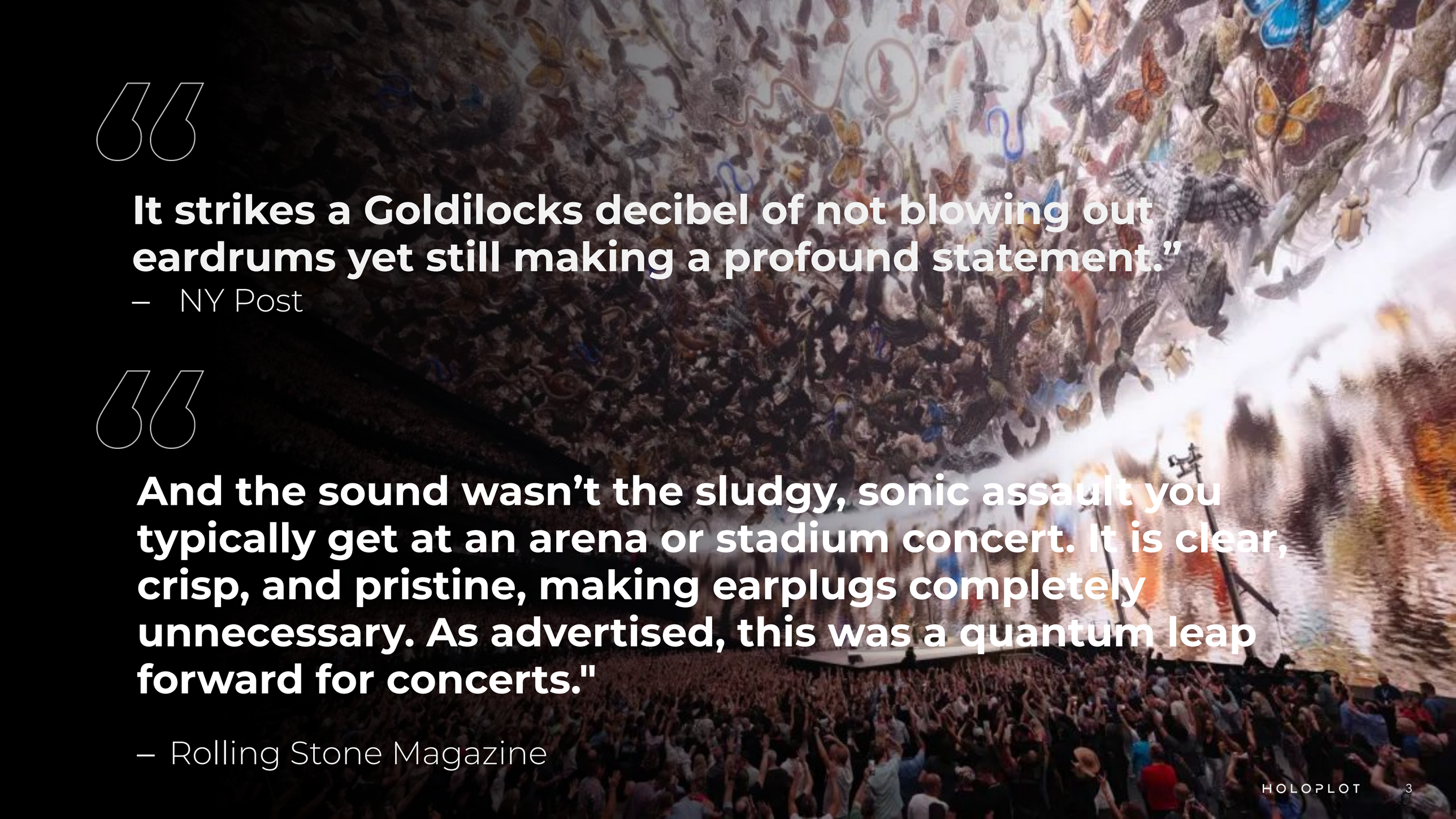
Creative canvas
On unprecedented scale

The grand vision for the most advanced concert venue on the planet, the Sphere in Las Vegas was to provide audiences with a next-generation live entertainment experience, including enveloping audio in headphone quality, that would match the extravagant visual aspect of the venue.

U2 opened this marvel of AV technology with *Achtung Baby*, a residency that quickly needed to be extended due to demand. Oscar-winning director Darren Aronofsky's film *Postcards from Earth* put the immersive capabilities of the space to the test. Both shows have set the bar high for what audiences can expect to see at Sphere in the future.

The venue contains the world's largest, fully integrated, yet invisible, concert-grade audio system developed by HOLOPLOT to deliver on this grand vision and was the natural choice by MSG Entertainment.

…but how exactly does it work?



It strikes a Goldilocks decibel of not blowing out eardrums yet still making a profound statement.”

– NY Post

And the sound wasn’t the sludgy, sonic assault you typically get at an arena or stadium concert. It is clear, crisp, and pristine, making earplugs completely unnecessary. As advertised, this was a quantum leap forward for concerts."

– Rolling Stone Magazine

A Temple to the Arts”

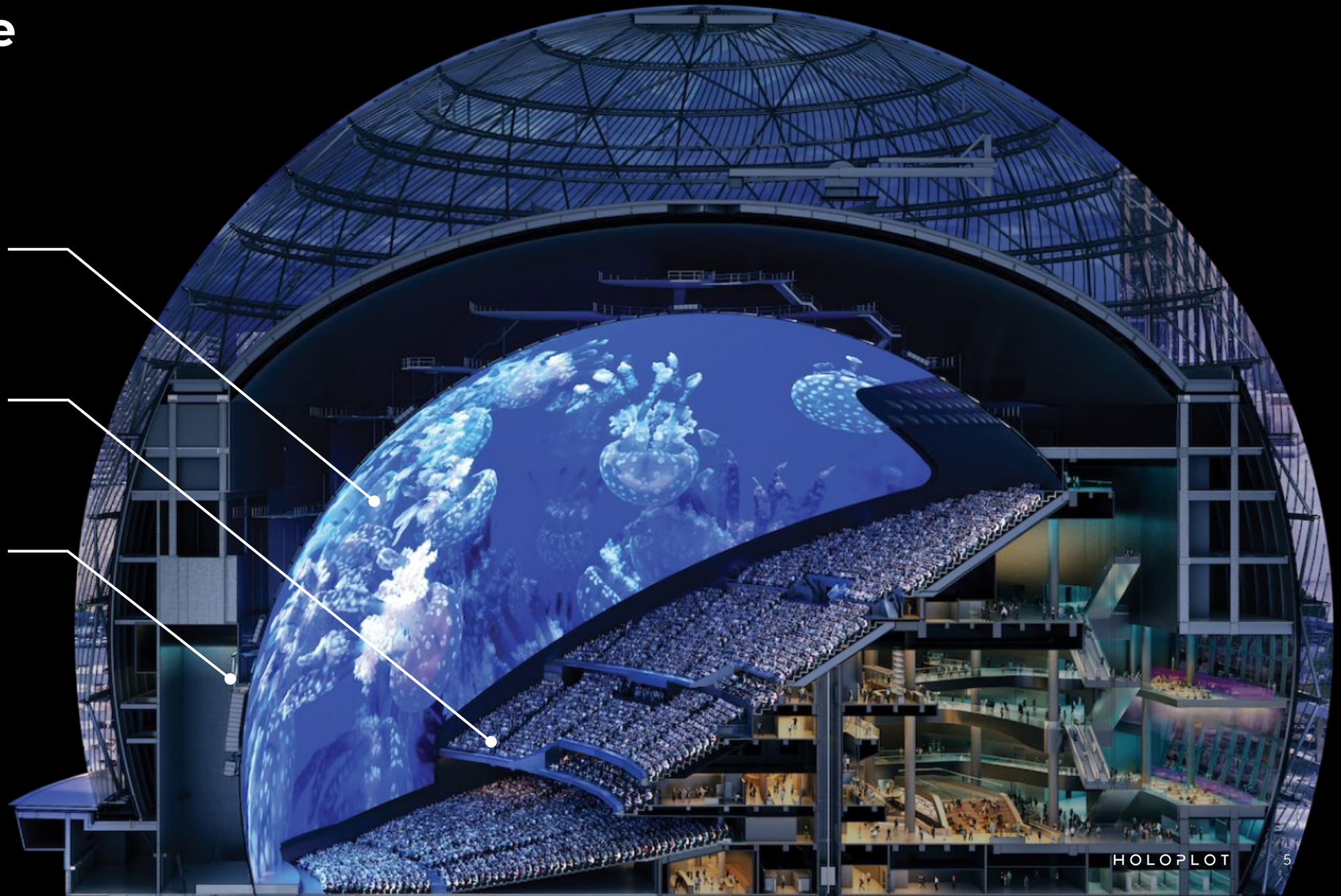
– Darren Aronofsky, Director

The Sphere
At a glance

18K, 160.000 sq foot LED media plane
9.5mm average pixel pitch

18,600 seats
Across a distance of 110m

1,578 X1 modules
distributed across the venue and behind the LED



The brief

Deliver next level concert sound, unconstrained by convention

There were three key goals when it came to creating a next-generation experience inside the world's most advanced live entertainment venue.

1) **The best sounding venue in the world…inside a spherical dome**
   The entire audience should receive the same and best listening experience at every position, effectively making every seat the best seat in the house. All of this within a spherically shaped LED dome, probably the acoustically most challenging environment of any entertainment venue.

2) **Fully immersive audio experience for all guests**

   In addition to exceptional quality stereo sound, the system had to provide a next-level immersive experience across the whole audience and ensure accurate sound localization in line with the visual screen content.

3) **No speakers visible**

   To ensure unobstructed sightlines the entire system had to be hidden behind the LED screen, no delay speakers were allowed.

The challenges
Heard, not seen

Such an ambitious brief came with its own unique challenges, the combination of which being only addressable with HOLOPLOT technology.

1) **Room acoustics**
   Spherical shapes are one of the most challenging acoustical environments. Reflections and echoes caused by the dome shaped interior have to be controlled to ensure intelligibility and uncompromised audio quality.

2) **Unprecedented scale**
   ~18.000 seats spread over three tiers and a total distance of 110m (~361 ft) from the main PA make it an extreme challenge to provide consistent coverage from front to back, with no delay lines allowed.

3) **LED integration**
   The XL, curved LED screen in front of the speaker arrays creates a physical obstacle for sound to pass through which had to be compensated for.

Creating this experience required us to go far beyond existing audio technology, and in HOLOPLOT we found a partner at the forefront of innovation to help achieve our vision and truly transform what is possible with audio.”

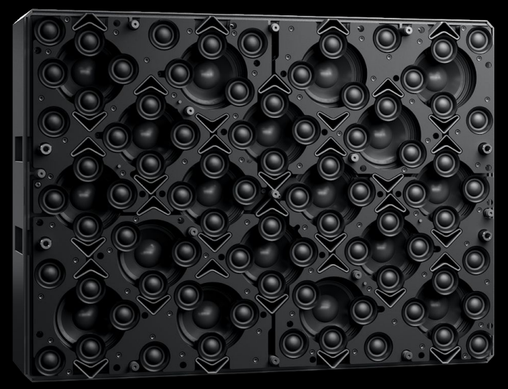
— David Dibble, CEO MSG Ventures

Leading the evolution in sound control
Through software

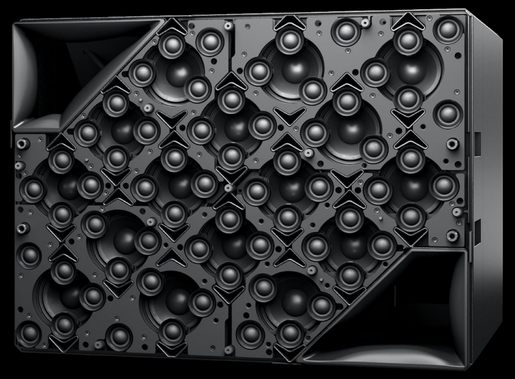
The groundbreaking HOLOPLOT X1 Matrix Array product series combines sophisticated hardware innovation with powerful proprietary software capabilities.

Utilizing 3D Audio-Beamforming and Wave Field Synthesis technology, X1 transforms how audio is delivered in large-scale venues, offering sound control more akin to controlling light, resulting in consistent, and crystal-clear concert-grade audio that provides each audience member with a truly exceptional and personalized listening experience.

HOLOPLOT's patented 3D Audio-Beamforming technology creates unique, highly controlled, and more efficient soundwaves, ensuring uniform coverage and addressing and solving the problem of the uncontrolled nature of sound wave propagation.



MD96
2-Way Matrix Array Loudspeaker



MD80-S
3-Way Matrix Array Loudspeaker

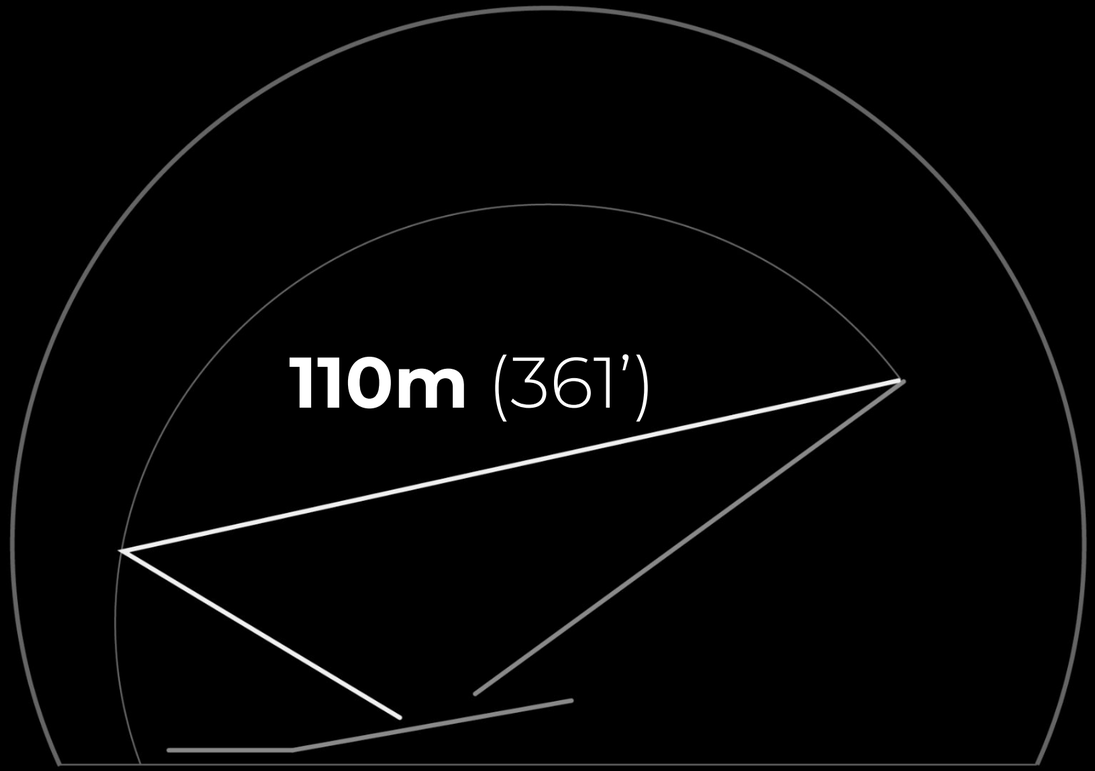
Realizing perfect sound over large distances
Optimized coverage beams

X1’s optimized coverage beams improve the performance and accuracy of sound delivery within a space, **providing better audio quality that doesn’t diminish over large distances**.

An optimized coverage beam not only **directs sound where needed** but also **avoids unwanted surfaces**, improving acoustic performance and **ensuring enhanced level and spectral homogeneity** over the audience area.

Its air absorption compensation feature is specifically designed for long-throw applications where high-frequency sound propagation is affected by air absorption.

Sophisticated software algorithms consider direction and distance of every beam, enabling users to achieve a balance between **spectral uniformity and maximum obtainable sound pressure level - even over large distances**.



Preventing reflections
High fidelity sound for every seat

Inside a spherical structure, sound waves are naturally reflected towards the center, affecting the distribution and quality of audio.

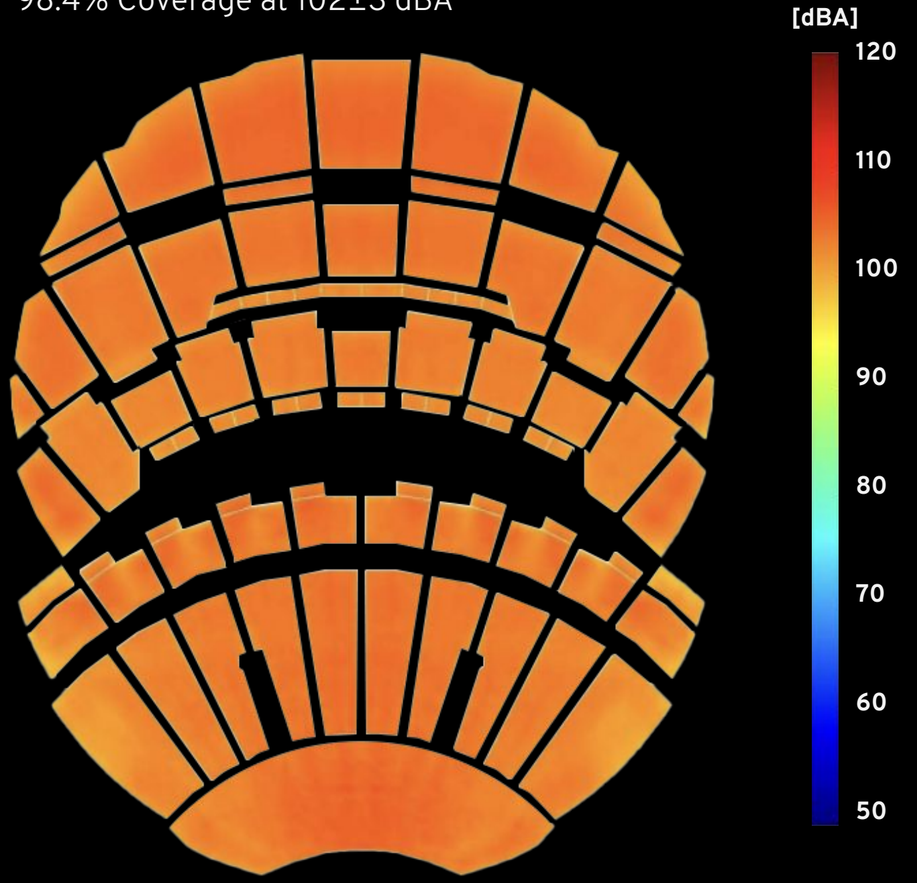
Conventional loudspeaker solutions like line array cannot prevent sound energy hitting reflective surfaces such as the highly reflective LED media plane at Sphere. This results in poor sound quality and distracting echos.

Target and avoidance zones

To optimize intelligibility, the HOLOPLOT system allows the user to designate all areas not regarded as listening areas, or areas that could cause reflections, as avoidance zones within the HOLOPLOT system design software.

HOLOPLOT technology **enables the precise steering of sound on both the vertical and horizontal axes**, allowing it to be contained within defined zones. This way, **undesired energy spill onto any room boundary is prevented**, therefore **significantly improving speech intelligibility and audio quality**.

Direct SPL - 31.5-16000 Hz, Broadband
98.4% Coverage at 102±3 dBA



Coverage achieved when the entire system is in use

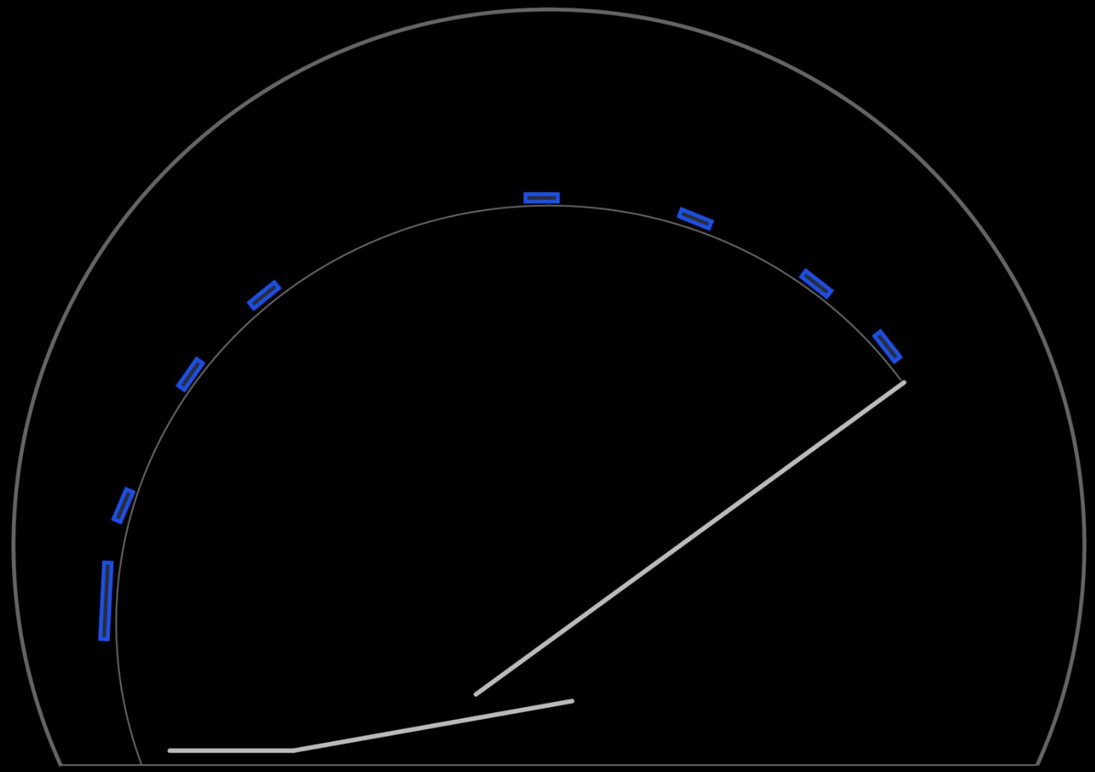
Invisible system
For unobstructed views

Media plane integration

Algorithmic compensation to address transmission loss

The entire X1 system inside Sphere is hidden by the supersized, curved LED screen. Despite its transparent nature, the screen still creates an obstacle for each driver signal to pass through, causing a loss of audio quality.

HOLOPLOT has developed **proprietary compensation algorithms** to retain the characteristic clarity of sound of X1 by compensating for the angle-dependent and frequency-dependent transmission loss created by the LED screen. The effects can be described similarly to those of a directional-dependent, spatial EQ.



Curved screen, straight arrays

The straight position of the X1 arrays keeps all sound sources (drivers) at a constant distance and angle relative to the screen. As a result, the transmission loss in a certain direction is the same for all drivers, allowing a uniform compensation across the array.

The effects of the transmission losses are then addressed in the 3D Audio-Beamforming capability unique to HOLOPLOT Matrix Array technology.

Result: Clear audio with virtually no colouration.

A layered design
For maximum flexibility

When a visual content almost fully surrounds the viewer, the entire plane cannot be processed by human vision. You have to move your head to truly capture all details of the content. Sound plays an important role in directing the gaze to specific moments and underlining certain points in the visual content.

To create immersive soundscapes and effects it’s paramount to first ensure the main audio coverage is consistent in level and high in quality. The HOLOPLOT X1 system enlarges the sweet spot to span across the entire seating area. This superior functionality allows for any creative effects or localized audio to be more effective and impactful.

The system at Sphere is divided into layers which deliver not only an incredibly wide stereo image that even extends to the seats on the far left and right. It also offers extremely high spatial resolution, making it an unprecedented immersive toolkit for sound designers and mixing engineers alike.

One product, one unique system design.

The System
Large scale array meets distributed system

Sphere's HOLOPLOT system consists of approximately 1,600 permanently installed X1 Matrix Array modules, configured in multiple arrays for different purposes. Let's break them down:

1x *Proscenium Array* - 272x MD96 & 192x MD80-S
33.6 Meters wide, 6.6 meters high it's the largest single array in the world and responsible for the main coverage of the audience area.

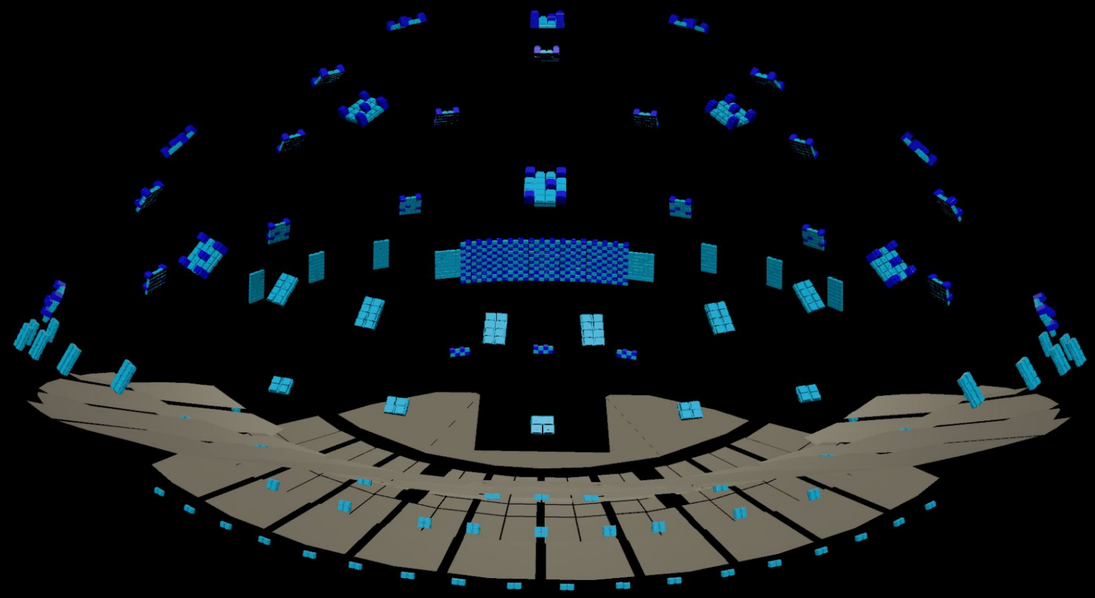
28x *Environmental Arrays* - 15x MD96 and 5x MD80-S each
distributed across the LED screen to create immersive coverage

6x Effects (FX) *Arrays* -24x MD96 each
extend the audio imaging of the proscenium array.

71x *Surround Arrays*
situated behind individual audience sections

12x *Under-Balcony Delays*
provide coverage for the audience underneath the main balcony

10x *Side-Fill Arrays* & 6x Low Fill Arrays
extend the coverage for audience on the edges and close to the stage



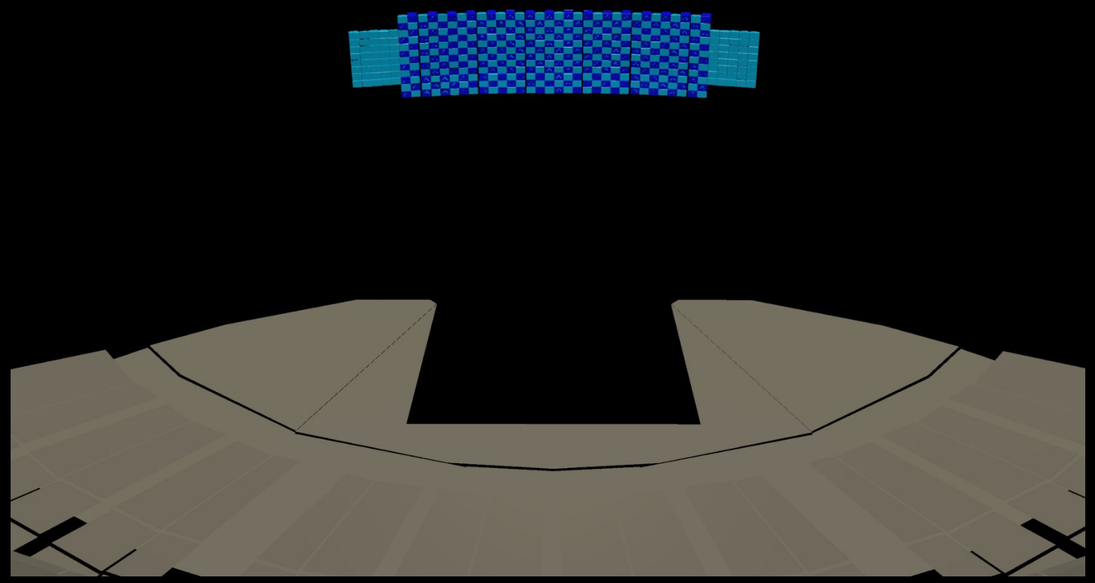
Proscenium Array
Full coverage from front to back

With 464 modules, a surface area of over 200m2, the ***Proscenium Array*** is not only the largest array in the system design, it's also the largest in the world. Together with the ***FX Array Extension*** it's responsible for the powerful, crystal-clear and even coverage of the entire audience area.

The size of the array is predominantly driven by the desire for high resolution localisation across the main portion of the media plane.

The array follows the curvature of the LED screen and despite pointing down allows for consistent audio to reach even the last row of seats at 110m distance, and no need for delay lines.

Optimized beams are aware of their relative position to the audience and digitally place the energy where it's desired, thanks to the digital sound control via 3D Audio-Beamforming in all three dimensions.

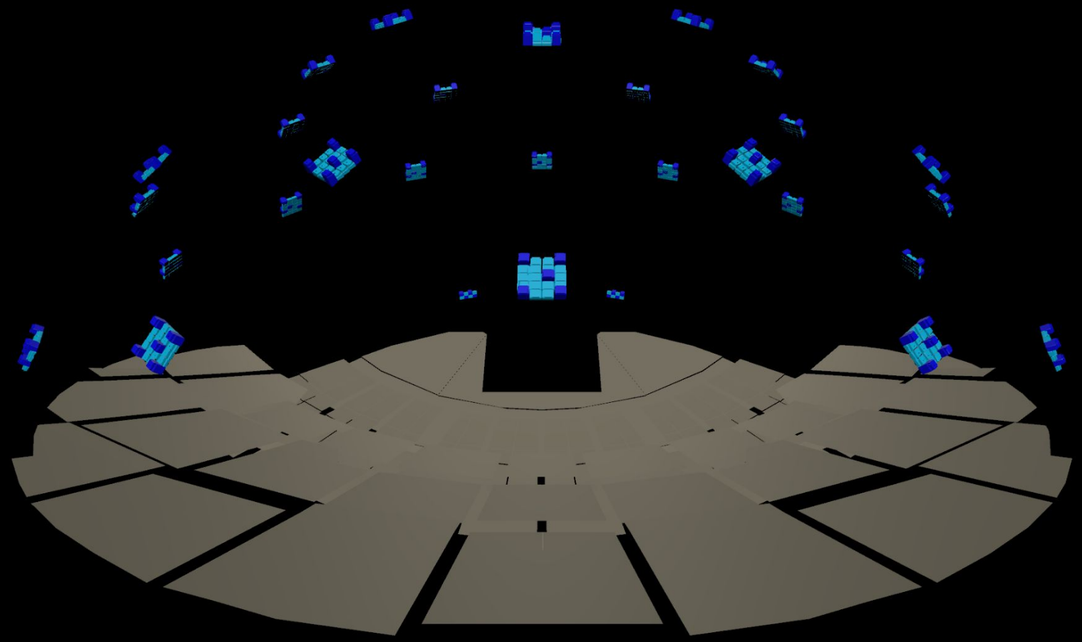


Environmental layer
Uncompromised creative freedom

The entire environmental layer consist of 28 ***Environmental Arrays***, in combination with ***Surrounds*** and ***Fills***. Together, these offer a creative palette to create fully immersive sound designs. Each array is powerful enough to cover the whole venue and thereby offers accurate localisation across the entire audience.

The number of arrays enables a very high spatial resolution across the whole audience areas and offers a plethora of creative options for artists and sound designers.

The distribution of the Environmental layer arrays combines with the 3D Audio-Beamforming capability of each individual module, providing consistent coverage and audio localization for the entire audience.



You can pinpoint a location, point at it, and send audio with such a degree of technical excellence that you can hit a spot 500ft away. I was, like, oh my God, this is the future of our industry...

There's an incredible acoustic intimacy about the venue; it's just a brilliant place to get a really good quality sound."

— Joe O'Herlihy, FoH Engineer for U2

Coverage modes
Uncompromised quality

The Sphere X1 sound system has two venue coverage modes that are instantly recallable by operators and/or the show control system, providing added flexibility.

Each coverage mode has variations that automatically adjust and compensate for changes in atmospheric conditions such as temperature and humidity. This allows the venue to provide consistent sound quality no matter what the current environmental conditions are.

01

Full Venue Coverage Mode

This mode sets each array to cover the entire venue evenly. This mode is used for the U2 shows for example.

02

Immersive Coverage Mode - (10,000 immersive seats)

This mode sets the coverage pattern of each array to cover only the 10,000 immersive seats. This mode is used for *Postcards from Earth*.

The advantage of this mode is that the sound quality is more intimate. Acoustic reflections are minimized, resulting in sound that seems to be emanating from the nearfield speakers.

Input formats
Unlimited creative freedom

The X1 system can reproduce creative audio content from a simple MONO source and up to 256 channels of maximum granularity.

Artists connect to the audio system via, Dante, AES67/Ravenna, AES 3, or MADI. The mixing/operational mode is selected by a simple touch screen interface.

Programmed and Commissioned formats include:

Mono Stereo LCR LCRS

5.1 / 5.1.2 / 5.1.4 7.1 / 7.1.2 / 7.1.4

9.1.2 / 9.1.4 / 9.1.6 10.1 11.1 13.1

22.2 LIVE 24.8 8.0 Effects Matrix

Signal chain overview

Audio over IP (AES67 / RAVENNA)

Control over IP

Beam settings

Preconfigured into presets by HOLOPLOT design tools, including all beam settings, tuning settings and screen compensation

Input sources

Multiple options including live acts, audio playout and gaming

Show control (Smart Monkeys)*

Integrates HOLOPLOT API for preset switching, adjustment of environmental conditions, watchdogs, monitoring

HOLOPLOT Controllers

Gateway for control and monitoring, apply presets / settings

LAWO A__UHD Cores

IP network DSP for AES67 / RAVENNA

Audio delivery

HOLOPLOT
Audio Modules

Note: system is fully redundant (control and audio), automatic LAWO A__UHD stream failover via LAWO Home

*** Note**: HOLOPLOT Control (UI) is used for metering, detailed health monitoring, system event logging, and routing audio streams